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PCT/GB2005/001223.

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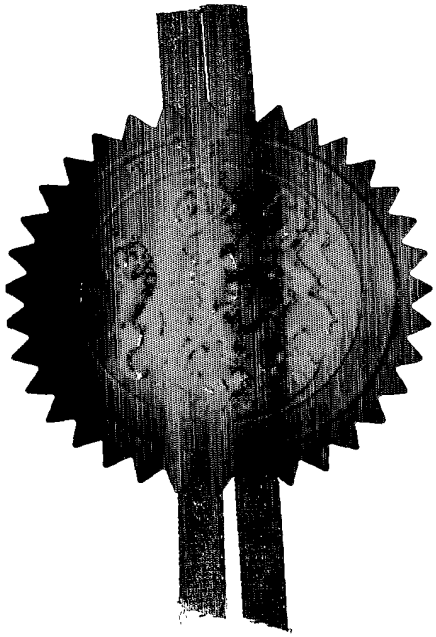

Signed

Dated 20 April 2005

Patents Form 1/77

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(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
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NP10 8QQ

1. Your reference — **87253/13181/03**

2. Patent application number *(The Patent office will fill this part in)* — 0408349.9

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

EASTMAN KODAK COMPANY
343 STATE STREET
ROCHESTER
NEW YORK 14650-2201
UNITED STATES OF AMERICA

Patents ADP number *(if you know it)* — 00423020001

If the applicant is a corporate body, give the country/state of its incorporation — **NEW JERSEY**

4. Title of the invention — **OPTIMUM USAGE OF PROCESSING SOLUTION IN PRINTING**

5. Name of your agent *(if you have one)* — **B BARKER**

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

KODAK LIMITED
PATENTS, W92-3A
HEADSTONE DRIVE
HARROW
MIDDLESEX HA1 4TY

Patents ADP number *(if you know it)* — 1024001

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of Filing *(day / month / year)*

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

	Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request? — **YES**

Answer YES if:

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.

Otherwise answer NO (See note (d)

Patents Form 1/77

9. Accompanying documents: A patent application must include a description of the invention.
Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	4
Claim(s)	1
Abstract	1
Drawing(s)	2 x2

10. If you are also filing any of the following, state how many against each item.

Priority Documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	
Request for preliminary examination and search (Patent Form 9/77)	
Request for substantive examination (Patent Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature(s) B Barker Date 14 APRIL 04

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

B BARKER **020 8424 5177**

brenda.barker@kodak.com

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Optimum usage of processing solution in printing

Field of the Invention

This invention relates to photographic processing, more particularly to processors which have a very small print volume compared to the size of material being printed.

Background of the Invention

To prevent the working characteristics of a bath of photographic developer from changing during development of a quantity of exposed silver halide photographic material, and also to maintain the volume of the developer, it is common practice to add a replenisher. Such a replenisher is usually a more concentrated aqueous solution of principal developer constituents that are consumed during development. The replenisher has a reduced concentration of components released during development so that these compounds are diluted. In this way the developer tank solution can be maintained constant in composition.

The amount of replenisher required to keep the activity of the processing bath constant is dependent on the amount of chemical used or produced during processing. For example, dark prints (e.g. fireworks) use more developing agent in the developer to form a dense image compared to a light image (e.g. snow or beach scenes). If the negative is scanned, either to create a digital file for subsequent digital printing, or to measure its density, the density information can be used to adjust the replenishment rate using an appropriate algorithm. An example of such a method of controlling rate of replenishment is disclosed in US 5518845.

Problem to be solved by the Invention

Replenishment is usually carried out by pumping liquid into the processor. A change in replenishment rate can be achieved by changing the pump rate or by changing the period that a constant flow rate pump pumps for. If, for example, a processor contains 10ml of liquid and is replenished at 100ml/m^2 one tank turnover volume of liquid takes place for every 0.1m^2 material processed. This

corresponds to about 6 100x150cm prints. If in one order the print density varies greatly from one end to another, for instance, the replenishment rate would have to vary greatly. This would mean either having a continuous pump designed to pump over a large range of rate, perhaps from 30-400ml/m^2, or changing the time between pulses in a pulsed pump with a ratio of about 1:13. This is difficult to achieve with a variable speed pump and if the space between pumps with a pulsed pump is varied the tank concentration of chemical will oscillate with the same frequency. This would give rise to an undesirable variation in density along a print.

The invention aims to reduce the rate of change of replenishment rate required during an order when processed in a very small volume replenished processor. This in turn reduces the likelihood of replenishment errors during the processing of a print and also reduces the cost of pumps and pump control equipment. If the replenishment rate is changed during a print there will be a change along the print. This amount is dependent on the magnitude of change. By reducing the size of the change the variability along the print will be reduced in proportion.

Summary of the Invention

In very low volume systems or single use systems the seasoning of the chemistry and chemical usage can be affected by the Dmin/Dmax ratio within an order and also the distribution of different density prints within an order. The present invention relates to the organisation of prints within an order so that variation in seasoning effects and replenishment is minimised and within the order the variation in chemical usage from print to print is optimised. In digitally exposed systems it is possible to obtain the average density of each print within an order and then re-shuffle the order to a sequence which would achieve the maximum advantage for the chemical processing stage.

According to the present invention there is provided a method of printing an image onto photographic material comprising obtaining digital density information of a print order comprising a number of images, determining an

optimum sequence of printing the images in the order, and printing the images in the optimum sequence.

Advantageous Effect of the Invention

The present invention helps maintain the chemical stability of very low volume systems and single use systems. This in turn maintains consistency of density of prints or sensitometry. It is possible that the amount of processing solution can be optimised.

Brief Description of the Drawings

The invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a graph illustrating the variation in density found in example 1;

Figure 2 is a graph illustrating the variation in density found in example 2; and

Figure 3 is a graph illustrating the variation in density found in example 3.

Detailed Description of the Invention

A number of different density print scenarios were modelled with and without reordering and the average print density over a pair of prints estimated. If the replenishment rate is directly proportional to the density this average value could be used to control replenishment.

Example 1

Using Excel ™, a set of prints with random densities between 0 and 1.8 was simulated. The prints were sorted into density order and then re-ordered such that the densest was printed adjacent to the least dense, then the next densest next to the next least dense etc. The average running density of the pair were calculated. Figure 1 compares the density averaged over two prints for both the original sequence and the re-ordered sequence. From Figure 1 it can be seen that the variation in density was greatly reduced by re-ordering the pairs having the density distribution described above.

Example 2

Using Excel ™, a set of prints with low densities at the beginning of the order and high densities at the end of the order was simulated. The prints were sorted such that the densest was printed adjacent to the least dense, then the next densest next to the next least dense etc. The average running density of the pair was calculated. Figure 2 compares the density averaged over two prints for both the original sequence and the re-ordered sequence. From Figure 2 it can be seen that the variation in density was greatly reduced by re-ordering the pairs having the extreme density distribution described above.

Example 3

Using Excel ™, a set of prints with a normal distribution of densities about a mean of one was simulated. The prints were sorted into density order and then re-ordered such that the densest was printed adjacent to the least dense, then the next densest next to the next least dense etc. The average running density of the pair was calculated. Figure 3 compares the density averaged over two prints for both the original sequence and the re-ordered sequence. From Figure 3 it can be seen that the variation in density is greatly reduced by re-ordering the pairs having the more realistic density distribution described above

The above examples illustrate that the variation in seasoning effects and replenishment is minimised if the prints are re-organised within an order. The chemical variation is thus minimised.

The invention has been described in detail with reference to preferred embodiments thereof. It will be understood by those skilled in the art that variations and modifications can be effected within the scope of the invention.

Claims:

1. A method of printing an image onto photographic material comprising obtaining digital density information of a print order comprising a number of images, determining an optimum sequence of printing the images in the order, and printing the images in the optimum sequence.

2. A method as claimed in claim 1 wherein the images are printed in the sequence of the image having the highest density followed by the image having the least density, followed by the image having the next highest density, followed by the image having the next least density, the sequence being followed until all images are printed.

3. A method as claimed in claim 1 or 2 wherein the volume of solution used for printing in each process step is less than 100ml.

4. A method as claimed in claim 3 wherein the volume of solution is less than 30ml.

5. A method of controlling replenishment rate by printing an order of images as claimed in any preceding claim, whereby the variation in average print density is reduced from one print to another.

6. An apparatus for printing images onto photographic media comprising means for obtaining digital density of a print order comprising a number of images, means for determining an optimum sequence of printing the images in the order and means for printing the images in the optimum order.

Abstract

Optimum usage of processing solution in printing

The digital density information of a print order is obtained and an optimum sequence of printing the images of the order is determined that reduces the average print density form one print to another.

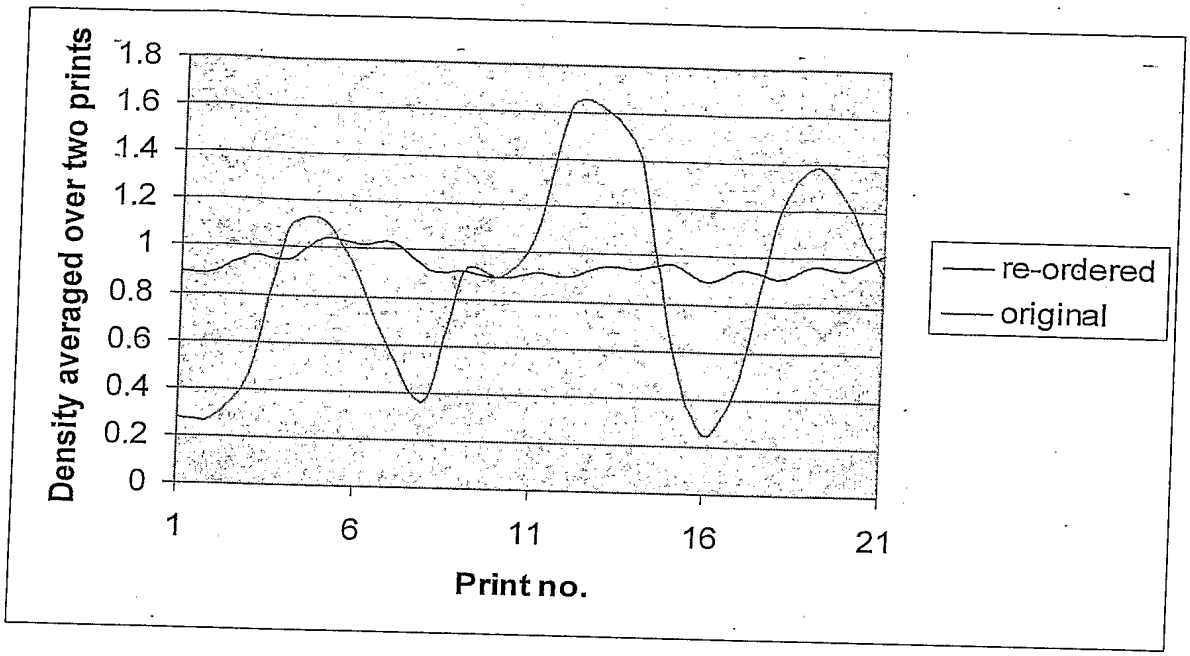
Density averaged over two prints
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1
6
11
16
21
Print no.
re-ordered
original

Fig. 1

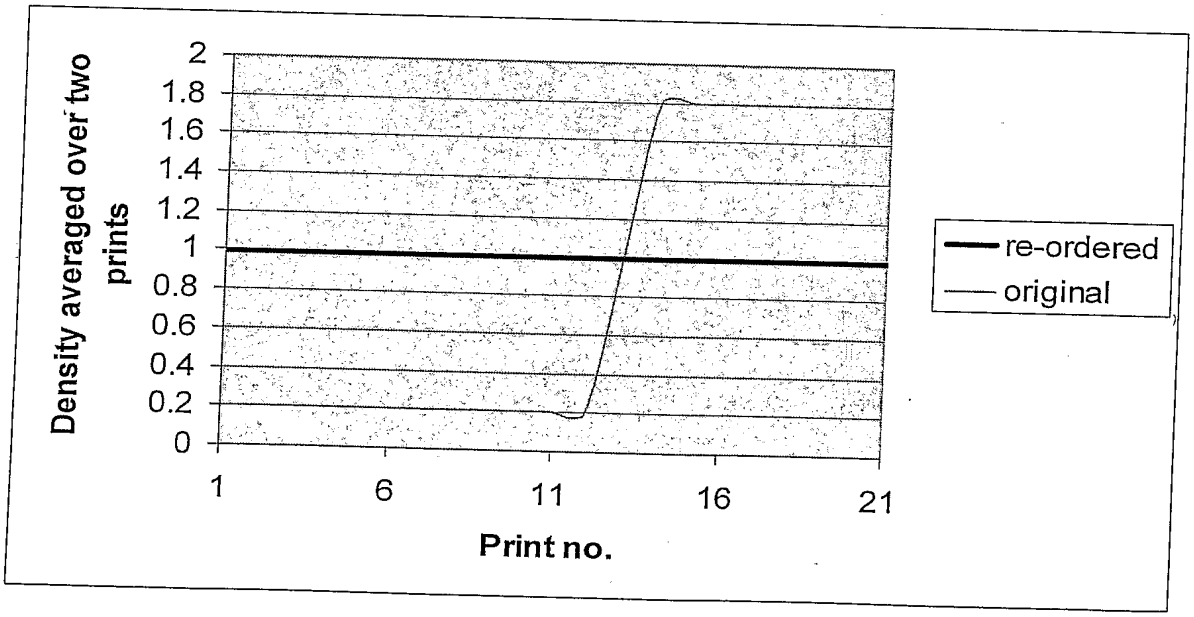
Density averaged over two prints
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1
6
11
16
21
Print no.
re-ordered
original

Fig. 2

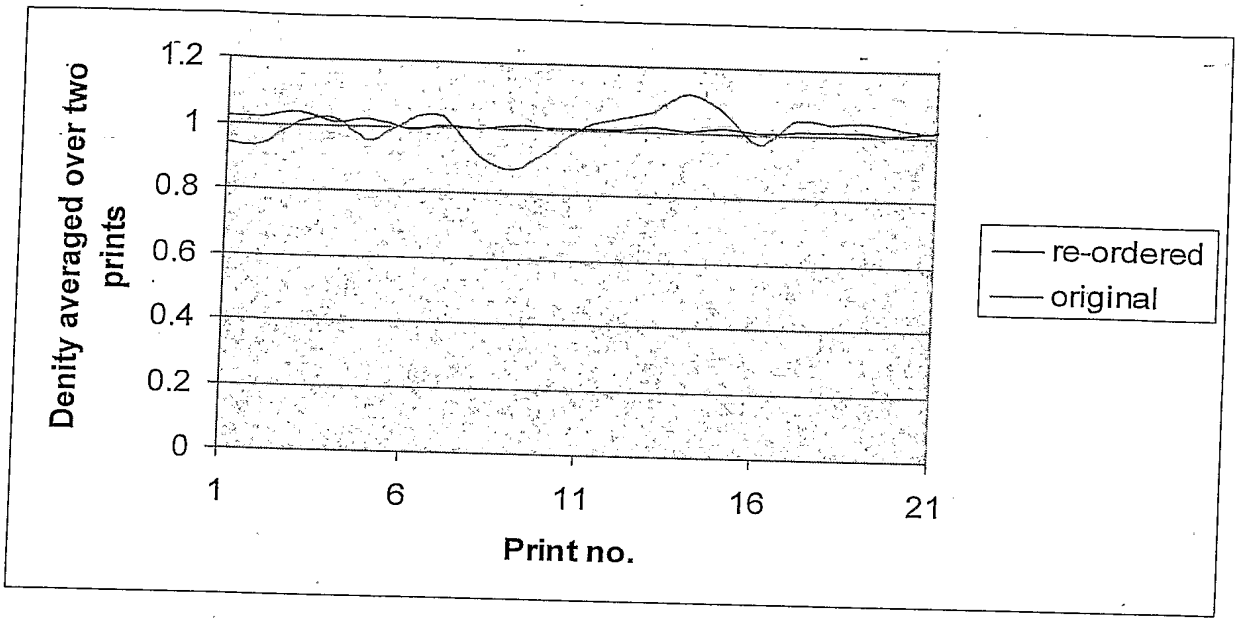
Denity averaged over two prints
1.2
1
0.8
0.6
0.4
0.2
0
1
6
11
16
21
Print no.
re-ordered
original

Fig. 3